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by Andrew Heisz, Geranda Notten and Jerry Situ

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. not available for any reference period
.. not available for a specific reference period
... not applicable
0 true zero or a value rounded to zero
0^s value rounded to 0 (zero) where there is a meaningful distinction between true zero and the value that was rounded
^{p} preliminary
^{r} revised
x suppressed to meet the confidentiality requirements of the *Statistics Act*
^{E} use with caution
F too unreliable to be published
* significantly different from reference category ($p < 0.05$)

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The association between skills and low income

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Overview of the study

This article explores how skill proficiencies are related to household income for Canadians aged 16 to 65 using data from the first wave of the Longitudinal and International Study of Adults (LISA), conducted in 2012. The article also demonstrates how the relationship between skill level and low income changes after controlling for other characteristics known to increase the risk of low income.

- In 2012, 17% of Canadian adults aged 16 to 65 had a literacy score corresponding to level 1 and below, meaning that they could only find single pieces of information in shorts texts or only had a basic vocabulary. About 13% were in the two highest categories of literacy skills (level 4 and level 5).
- The median household income for individuals who were in the lowest category of literacy proficiency (level 1 and below) was $49,700, compared with $84,600 among those who were in the two highest categories (level 4 and level 5).
- Among individuals in the lowest category of literacy proficiency in 2012, 29% were in a low-income household (households whose income is below the after-tax Low Income Measure), compared with approximately 8% for those in the two highest categories.
- After controlling for other characteristics known to increase the risk of low income, individuals who were in the lowest level of literacy proficiency continued to have a low-income rate higher than individuals who were in the highest levels. The magnitude of the difference, however, was smaller (12 percentage points instead of 21).
- Differences in skill level also help explain part of the higher incidence of low income among certain groups, including groups with low educational attainment and recent immigrants.

Introduction

Certain population characteristics such as immigrant status, being an Aboriginal person, having an activity limitation, having low education and being in a lone-parent family have been found to be concentrated among the low-income population.[1] This information could be useful to policymakers since understanding the characteristics of individuals in low income can inform the design of effective programs.

One population characteristic that has received less attention is skill level, which refers specifically to fundamental literacy, numeracy and problem-solving skills. Intuitively, skills should also be negatively correlated with low income. Presumably, persons with lower skills have lower wages and thus a higher likelihood that their income falls below the low-income threshold. However, there is little evidence on the scope of these relationships.

Other research has shown that skills have a positive effect on individual earnings even after controlling for other characteristics such as educational attainment.[2] Building on this evidence, this article examines the relationship between skills and household income. Specifically, this study examines whether having low skills increases the likelihood of living in a low-income family, and whether the effects persist after controlling for other factors known to increase the risk of low income.

The study uses data from the Longitudinal and International Study of Adults (LISA). LISA is unique in that it combines skill data from the Programme for the International Assessment of Adult Competencies (PIAAC) with household income information (see *Data sources, methods and definitions*). The skills data consist of an assessment in each of three domains: literacy, numeracy and problem solving in technology-rich environments. As done in other studies, the focus is on literacy scores because of a high correlation between the three domains.[3] The three domains assessed in PIAAC rely on the same core cognitive processes,[4] therefore using only numeracy or problem-solving scores would produce similar results.

LISA interviews were conducted between November 2011 and June 2012, whereas income information refers to the 2011 calendar year. This article refers to this collection period as "2012" for brevity.

Literacy skills and income

In 2012, 17% of Canadians aged 16 to 65 had a literacy score that placed them in level 1 and below (Table 1). Individuals in this category, for example, can only locate single pieces of information in shorts texts in the absence of other distracting information, or demonstrate only basic vocabulary. Remaining Canadians scored in higher categories with 13% achieving level 4 and level 5. Scoring in this category indicates a higher literacy proficiency, with individuals in it demonstrating, for example, being able to integrate information from multiple dense texts and being able to reason by inference.

Literacy skill level and household income are positively related. At $84,600, the median household income for individuals with the highest literacy proficiency (level 4 and level 5) was 70% higher than it was for those with lowest literacy proficiency (level 1 and below), and 33% higher than for those in the level 2 proficiency category.

The bottom row of Table 1 shows the low-income rates, using the after-tax Low Income Measure (LIM–AT). With the LIM–AT, individuals are considered to be in low income if they are living in a household whose income (adjusted for the size of the family) is lower than 50% of the overall median.

Table 1
Distribution, median income and low-income rate of Canadians aged 16 to 65 by PIAAC literacy level, 2012

		PIAAC literacy level			
	All	Level 1 and below (low)	Level 2	Level 3	Level 4 and level 5 (high)
			percent		
Percent with this literacy level	100	17	32	37	13
			dollar		
Median household income (in 2011)	67,958	49,696	63,520	74,568	84,583
			percent		
Low-income rate (in 2011)	16	29	17	11	8

PIAAC = Programme for the International Assessment of Adult Competencies
Source: Statistics Canada, Longitudinal and International Study of Adults (LISA), 2012.

The results show a clear association between skill level and the incidence of low income. The low-income rate for the highest literacy proficiency group was, at 8%, one half the level observed in skill-proficiency group 2 and nearly one-quarter the level seen in the lowest proficiency group. In contrast, the low-income rate was about 29% among those who were in skill-proficiency group 1 or below.

The subgroup with both lower skills and low income can be considered at a particular disadvantage.[5] Estimates suggest that, in 2012, this group represented about 5% of Canadians aged 16 to 65.[6]

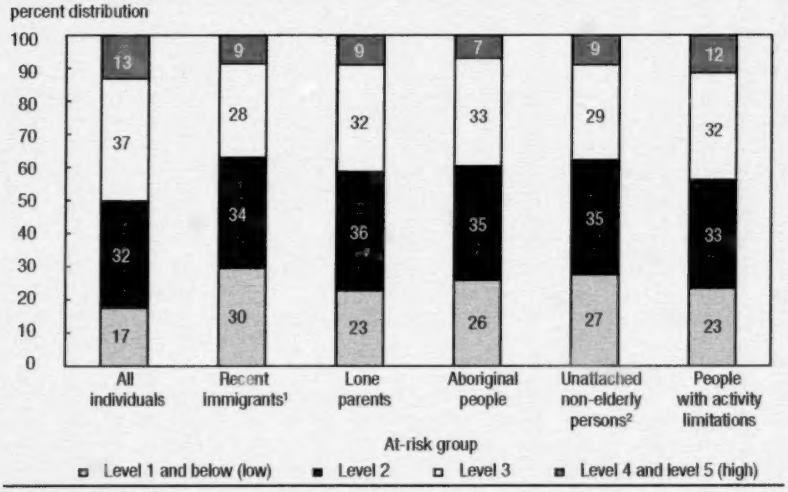
Skills and other factors associated with low income

Research on low income has emphasised certain at-risk groups. These are demographic groups that have higher low-income rates, such as recent immigrants, Aboriginal persons, unattached non-elderly persons and people with activity limitations.

In each case, at-risk groups have a skill profile that tends to be closer to having a lower literacy level (Chart 1). For example, while 17% of all persons had a literacy score of in the lowest category, 30% of recent immigrants, 26% of Aboriginal persons, 27% of unattached non-elderly persons and 23% of people with an activity limitation had a literacy score level in the lowest category in 2012.

Education and skills are also highly correlated—the generation of skills is an important output of the educational system, and the presence of basic skills such as

Chart 1
PIAAC literacy level for groups at high risk of low income, 2012

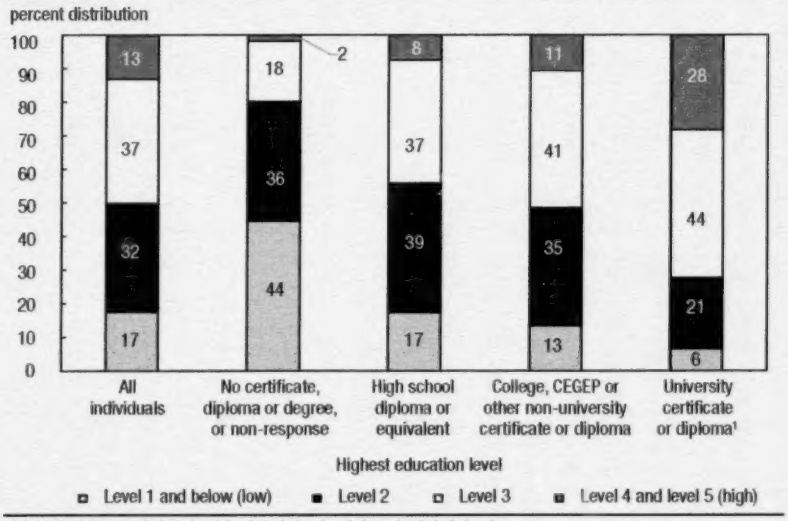


1. Immigrated after 2002.
2. Persons aged 45 to 64 living alone or with others to whom they are unrelated.

Note: PIAAC = Programme for the International Assessment of Adult Competencies.

Source: Statistics Canada, Longitudinal and International Study of Adults (LISA), 2012.

Chart 2
PIAAC literacy level for groups at high risk of low income, 2012



1. Includes below bachelor's level, bachelor's level and above bachelor's level.

Note: PIAAC = Programme for the International Assessment of Adult Competencies.

Source: Statistics Canada, Longitudinal and International Study of Adults (LISA), 2012.

literacy are important prerequisites to entering higher education. For example, among individuals with a high school diploma as their highest education level, 8% scored a level 4 or higher on the literacy assessment compared with 28% among those with a university degree or higher (Chart 2).

Educational attainment, however, is not perfectly correlated with literacy levels—some people with a university degree had lower literacy scores,[7] while others had higher literacy scores despite having only a high school education.

The relationship between low income and skills after controlling for other factors

The previous section showed the relationships between skills and low income. It showed that skills were related to demographic characteristics, such as educational attainment, as well as whether the individual was a member of an at-risk group. In this section, a regression Model is used to test whether the relationship between skills and low income persists once controls for other characteristics common to low-income populations are applied.

Several low-income models are tested. Each Model controls for a different number of factors that are expected to affect low income such as educational attainment, immigrant status, the presence of activity limitations, family type and other demographic characteristics. The strategy is to compare the regression coefficient estimates across multiple models to see if the relationship between skills and low income persists as various control factors are added.

Table 2
Percentage of individuals whose household income was below the after-tax Low Income Measure (LIM–AT), 2012

	Percent of population	Percent below LIM (in 2011)
PIAAC literacy level		
Level 1 and below	17.4	29.3
Level 2	32.4	16.7
Level 3	37.0	11.1
Level 4 and level 5	13.2	8.3
Highest education level		
No certificate, diploma or degree	16.0	26.5
High school diploma or equivalent	25.9	18.7
College, CEGEP or other non-university certificate or diploma	31.3	13.3
University certificate or diploma	26.8	9.2
Immigrant		
Yes – immigrated after 2002	6.4	24.8
Yes – immigrated in 2002 or earlier	13.8	16.1
No	79.8	14.9
Activity limitation		
Activity limitation	19.3	26.5
No activity limitation	80.7	13.1
Family type		
Couple family	67.6	8.7
Lone parent	10.2	30.7
Person not in a census family	22.2	30.2
Aboriginal people		
Yes	3.2	22.7
No	96.8	15.5
Unattached non-elderly persons[1]		
Yes	9.4	33.5
No	90.6	13.9
Sex		
Male	50.1	15.2
Female	49.9	16.3
Age		
16 to 19	7.1	14.9
20 to 24	10.3	25.6
25 to 34	20.1	14.3
35 to 44	19.6	14.0
45 to 54	22.7	14.5
55 to 65	20.3	15.6
Province		
Atlantic	6.8	19.0
Quebec	23.2	18.0
Ontario	39.2	16.6
Prairies	17.9	10.2
British Columbia	12.9	14.8

1. Persons aged 45 to 64 living alone or with others to whom they are unrelated.
PIAAC = Programme for the International Assessment of Adult Competencies
Source: Statistics Canada, Longitudinal and International Study of Adults (LISA), 2012.

The descriptive statistics for the variables included in the regression models are shown in Table 2. Low income was higher for persons with less education (19% among persons with at most a high school diploma versus 9% among university degree holders). Immigrants who arrived in Canada in the 10 years preceding the interview had a low income rate of 25%, which was higher than the 15% rate for the Canadian-born. Persons with activity limitations had a low-income rate twice that of those without a limitation (27% versus 13%). Unattached persons (defined as persons not in a census family) and persons in a lone-parent family each had a low-income rate three times larger than that of couple families (about 30% versus 9%).

The results of the regression exercise are shown in Table 3. The coefficients represent the increased or decreased probability of being in low income relative to the omitted category. Five models are shown, each with a different set of independent variables.

Model 1 shows the results when including only basic demographic controls (age, sex and province) and literacy variables. It shows that the low-income rate for persons scoring level 1 and below is 21 percentage points higher than the rate for those scoring level 4 or level 5 (the omitted category), when holding basic demographic variables constant.

Model 2 adds controls for educational attainment. The addition of educational attainment to the Model reduces the size of the coefficients on the skill variables. For example, the coefficient for proficiency level 1 and below drops from 0.213 to 0.162, or by nearly one-quarter.

Model 3 adds controls for immigrant status and Model 4 adds having an activity limitation and family

Table 3
Regression models with low income as a dependant variable

	Regression model				
	Model 1	Model 2	Model 3	Model 4	Model 5
PIAAC literacy level					
Level 1 and below	0.213 ***	0.162 ***	0.149 ***	0.121 ***	...
Level 2	0.085 ***	0.058 ***	0.050 ***	0.042 **	...
Level 3	0.028 *	0.015	0.011	0.010	...
Level 4 and level 5 (ref.)	...	...	...	...	...
Highest education level					
No certificate, diploma or degree	...	0.124 ***	0.134 ***	0.122 ***	0.177 ***
High school diploma or equivalent	...	0.064 ***	0.072 ***	0.062 ***	0.086 ***
College, CEGEP or other non-university certificate or diploma	...	0.020	0.029 **	0.023 *	0.039 ***
University certificate or diploma (ref.)	...	...	...	...	...
Immigrant					
Yes – immigrated after 2002	...	...	0.090 ***	0.122 ***	0.150 ***
Yes – immigrated in 2002 or earlier	...	...	0.005	0.025	0.044 ***
No (ref.)	...	...	...	...	...
Activity limitation					
Activity limitation	...	...	...	0.106 ***	0.108 ***
No activity limitation (ref.)	...	...	...	...	...
Family type					
Lone parent	...	...	...	0.183 ***	0.190 ***
Person not in a census family	...	...	...	0.202 ***	0.208 ***
Couple family (ref.)	...	...	...	...	...
Intercept	0.096 ***	0.074 ***	0.076 ***	0.000	0.024

... not applicable
* significantly different from the reference category (ref.) at 10%
** significantly different from the reference category (ref.) at 5%
*** significantly different from the reference category (ref.) at 1%
Note: PIAAC = Programme for the International Assessment of Adult Competencies
Source: Statistics Canada, Longitudinal and International Study of Adults (LISA), 2012.

controls. Each successive entry of control variables into the Model reduces the size of the coefficient on skills with little change to the education variables.

After all controls are entered into the model, the disadvantage associated with having lower literacy (level 1 and below) drops to 12 points, which continues to be a large and significant effect, but much smaller than the 21 points obtained without controls.[8]

Model 5 includes all variables except the literacy variables. Changes in the coefficients between Model 5 and Model 4 show the effect of literacy on the other variables. Coefficients for education and immigration status are larger than in Model 4, while coefficients for activity limitation and family types are unchanged. Thus, differences in skill level help explain part of the higher incidence of low income among low educational attainment groups and recent immigrants. The disadvantage associated with having at most a high school diploma falls from 9 percentage points (Model 5) to 6 points (Model 4). For recent immigrants, it reduces the disadvantage from 15 points to 12 points.

Conclusion

This study examines the relationship between skills and low income using data from the Longitudinal and International Study of Adults (LISA). The results show that being in low income is related to having lower literacy skills. The results indicate that the low income rate among persons with literacy skills in the lowest category was, at 29%, more than three times that of those who were in the highest categories.

This study also examined whether the relationship between skills and low income persists after taking other demographic factors such as education, immigrant status and having an activity limitation because previous research has shown that these are important "risk-factors" of being in low income. It finds that skills continue to matter even after these other controls are added in. The effect of skills on low-income, however, is muted due to correlations between skills and other risk factors. Moreover, the inclusion of skills reduces the importance of educational attainment and immigrant status, indicating that part of the higher incidence of low income among these groups is associated with lower skills.

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This article is an abridged version of the paper "The role of skills in understanding low income in Canada," originally published in 2015 in Measurement of Poverty, Deprivation, and Economic Mobility.[9]

Data sources, methods and definitions

Data sources

The dataset used in this research is from the first wave of the Longitudinal and International Study of Adults (LISA). LISA is a longitudinal household survey that collects social and economic data about the Canadian population every two years. The first wave collected data between November 2011 and June 2012.

LISA data contains both high-quality information on household income and direct measures of respondents' literacy, numeracy and problem-solving skills.

This study uses income data from LISA, which are obtained from annual income tax files provided by Canada Revenue Agency and other income sources for the year 2011. These data are collected for each family member aged 15 and over and summed to yield household income. In total, including children aged 0 to 14 from whom no income data were captured, LISA contains the income information of 32,133 respondents living in 11,458 households.

For households containing at least one individual between the ages of 16 and 65 (inclusive), one person per household was selected to complete the Programme for the International Assessment of Adult Competencies (PIAAC) assessment. Initiated by the Organisation for Co operation and Development (OECD), PIAAC is designed to assess the skills and competencies of working-age adults in 26 countries. In total, 8,598 LISA respondents completed the PIAAC assessment some time between November 2011 and June 2012. This study focuses on this subset of LISA respondents who completed a PIAAC assessment.[10]

Methods and definitions

PIAAC skills

The PIAAC skills measures consist of a direct assessment in three domains: literacy, numeracy and problem solving in technology-rich environments (PS–TRE). The assessed score in each of the domains is divided into different levels to facilitate interpretation.

The three domains assessed in PIAAC rely on the same core cognitive processes.[11] Thus, there is a high degree of correlation between the assessment scores. The correlation coefficient between literacy and numeracy scores is 0.87. Between literacy and PS–TRE, the correlation is 0.82 when the sample is restricted to respondents with assessments in both domains. Lastly, the correlation is 0.75 between numeracy and PS–TRE.

This study's models were tested using each skill score separately and combined. When included separately, each skill score had a statistically significant Model coefficient; however, when all skill scores were included, only literacy remained statistically significant. Thus, this study focuses mainly on literacy skills.[12]

In PIAAC, a skill assessment corresponding to level 1 and below represents a proficiency such as only being able to find single pieces of information in short texts in the absence of distracting information or having only a basic vocabulary. Scoring in the top categories (level 4 or level 5) indicates a higher proficiency. Scoring in these categories represents a proficiency such as being able to integrate information from multiple dense texts and reasoning by inference.[13]

Low Income Measure

For this study, the after-tax Low Income Measure (LIM–AT) is used. That is, individuals are considered to have low income if their adult equivalent adjusted (AEA) after-tax household income is below a threshold defined as 50% of the median AEA after-tax household income. The AEA adjustment accounts for potential economies of scale enjoyed by larger families.

Notes

1. See Echenberg (2012).
2. See Green and Riddell (2007).
3. These studies include Levels et al. (2014) or OECD (2013a and 2013b, Chapter 3)
4. See OECD (2012).
5. Green and Riddell (1997) suggest that persons with both low income and low skills could be "severely disadvantaged in terms of their ability to function in society" (p. 13).
6. That is to say, the proportion of the population in level 1 and below was 17%. Among people in this group, just under 30% were in low income.
7. See Hango (2014) for a discussion of factors associated with lower skills among university graduates.
8. An additional model was estimated that added controls for being an Aboriginal person and being an unattached non-elderly person. The coefficient for being an Aboriginal person was not statistically significant, while the coefficient for being an unattached non elderly person was statistically significant at 5%, but of a minor magnitude. The addition of these extra variables did not affect the estimates presented in Model 4.
9. See Heisz et al. (2015) for additional details.
10. Situ (2015) demonstrates that reliable estimates of skills can be produced using the PIAAC assessments in LISA.

11. See OECD (2012).
12. This approach is similar to the one used in Levels et al. (2014) and OECD (2013a and 2013b, Chapter 3).
13. Statistics Canada (2013) provides a broader examination of skills distributions of Canadians using the complete PIAAC sample, and a complete definition of each of the domains and the capabilities associated with the levels of the domains.

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